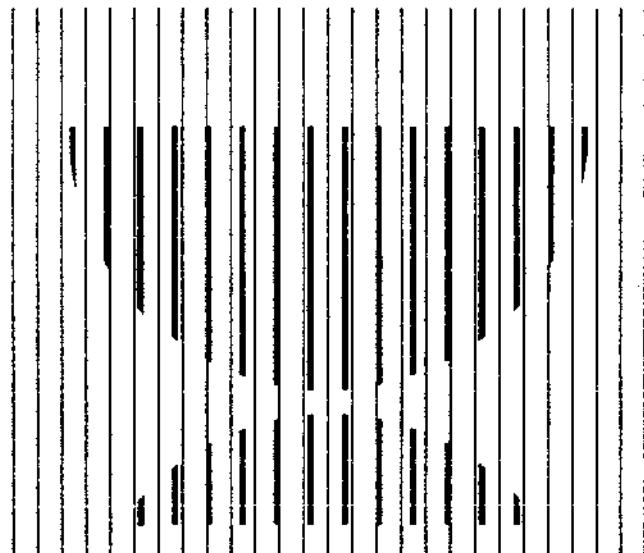


CBO STAFF MEMORANDUM

**ALTERNATIVE PROCUREMENT PROGRAMS
FOR THE B-2 BOMBER: EFFECTS ON
CAPABILITY AND COSTS**

April 1990



**THE CONGRESS OF THE UNITED STATES
CONGRESSIONAL BUDGET OFFICE
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This memorandum was prepared by the Congressional Budget Office (CBO) in response to several requests for information on the B-2 bomber program. These included requests by Senator Leahy and Senator Cranston, and by Representative Kasich. The work is also part of ongoing analyses being done at the request of the Defense Policy Panel of the House Armed Services Committee. In keeping with CBO's charter to provide objective and nonpartisan analyses, the memorandum makes no recommendations.

The cost analysis of the Administration's program, alternative programs, and operating costs was prepared by William P. Myers under the supervision of Michael A. Miller. The analysis of the effects of canceling or curtailing B-2 purchases was prepared by Bonita J. Dombey under the supervision of Robert F. Hale and John D. Mayer. Janice M. Johnson typed the many drafts and prepared the final draft for production.

NOTES

Unless otherwise indicated, all years referred to in this report are fiscal years.

Details in the text and tables may not add to totals because of rounding.

Unless otherwise indicated, all costs are expressed in billions of fiscal year 1991 dollars of budget authority.

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SUMMARY AND INTRODUCTION

Currently, the U.S. strategic bomber force consists of about 190 B-52 bombers plus 97 B-1B bombers. If there were a nuclear war today, the older of the B-52 bombers (the G models) would attack the Soviet Union with air-launched cruise missiles--small, pilotless drones that can be launched at long distances from their targets so that the bomber can stand off and avoid most of the radar and missile systems that make up the Soviet Union's extensive system of air defenses. Some of the newer B-52 bombers (the H models) would attack with cruise missiles and would also be used to penetrate Soviet air defenses and deliver gravity bombs and short-range attack missiles. The B-1B bombers would all be used as penetrators.

The bomber fleet is being modernized in several ways, the main one being the addition of the B-2 bomber. The Administration plans to buy 132 of these bombers that will incorporate stealth characteristics to help them avoid being detected and destroyed by Soviet air defenses. The B-2 bomber achieves its stealth characteristics through structural designs and radar-absorbing or deflecting materials that reduce radar signatures.

In addition to the B-2 bomber, the Department of Defense (DoD) is developing and procuring two new weapons. These include a new short-range attack missile (SRAM II) and an advanced cruise missile (ACM) that, compared with the current cruise missile, will have a longer range and additional stealth characteristics.

The B-2 bomber, and other bombers designed to penetrate Soviet air defenses, may be heavily favored by counting rules likely to be incorporated in the Strategic Arms Reduction Talks (START) treaty. START would limit most strategic offensive forces of both the United States and the Soviet Union. Each side would be limited to no more than 6,000 warheads of types that are counted under the treaty. The United States and the Soviet Union apparently have agreed that penetrating bombers would count as carrying only one warhead for purposes of START, even though the B-2 bomber could carry about 16 warheads. The United States has proposed that standoff bombers that fire cruise missiles (such as the B-52) would count as carrying 10 warheads.

This memorandum analyzes the costs and the effects of the Administration's program to buy 132 B-2 bombers as well as alternatives that buy 66 planes, 33 planes, or no planes at all. The memorandum also considers various rates of annual procurement.

CBO estimates that the Administration's program to buy 132 B-2 bombers will cost a total of about \$75 billion in 1991 prices. In the year of maximum funding, annual costs for the B-2 program would be about \$9 billion. Total costs could rise if various factors that the Administration expects will hold down costs do not work out as planned.

Last year, the Congress requested an examination of alternative plans that would reduce the total cost of the B-2 bomber program. The largest reduction--about \$41 billion--would be realized by canceling further procurement of the B-2 bomber but completing the remaining research and development program. Canceling the B-2 program would significantly reduce the capacity of the U.S.

bomber fleet to carry weapons, although under some assumptions the reduction in warheads actually available in war might be smaller. Moreover, if Soviet air defenses continue to improve, not buying more B-2 bombers could reduce the ability of the U.S. strategic bomber fleet to penetrate Soviet air defenses and deliver warheads on their targets.

The total cost of the B-2 program could also be reduced substantially by buying fewer total planes at high annual rates of procurement. For example, if the Congress approved the purchase of only 66 B-2 bombers, but bought those planes at the same rates planned by the Administration, then total costs would be reduced by more than \$18 billion below the cost of the Administration's program. However, this approach would still require spending about \$8.6 billion on the B-2 bomber program during the year of peak production.

Lower annual rates of buy would hold down this maximum annual spending, but lower rates are relatively inefficient. Thus, if the B-2 is bought at low rates, total costs would be reduced only if very few planes are bought. For example, the Congress could approve the purchase of B-2 bombers at three per year. This approach would hold maximum spending in any one year to no more than \$5 billion and, if only 33 bombers were purchased, would reduce total costs by more than \$18 billion below the cost of the Administration's plan. But if 66 bombers were purchased at three a year, total costs would increase by about \$21 billion above the cost of the Administration's program.

Slow rates of production are particularly inefficient for the B-2 bomber because of the program's complexity and because the bomber is reportedly being assembled at a factory that only produces one product--the B-2 bomber. The Congress should consider these significant economic inefficiencies before deciding to slow B-2 production as opposed to proceeding quickly with production or canceling it outright.

EFFECTS OF CANCELING OR CURTAILING B-2 PURCHASES

Many of the options presented in this paper would curtail purchases of the B-2 bombers or, in one case, cancel all further purchases. This section discusses the effects that canceling or curtailing the B-2 program would have on the warheads that could be carried by U.S. strategic forces and the ability of U.S. bombers to penetrate Soviet air defenses.

Loss of Warheads

If no additional B-2 bombers were purchased, the capacity of the U.S. bomber fleet to carry weapons would be decreased by about 1,700 on-line warheads in the long term. (On-line warheads include all warheads in the inventory less those whose delivery vehicles are in the maintenance pipeline or in overhaul.) The reduction would be significant when compared with the capacity that would be available if the United States bought the 132 B-2 bombers proposed by the Administration. It would decrease warheads carried by bombers by about one-third and warheads

carried by all the strategic nuclear systems covered by START by about one-sixth (compare Cases I and II in Table 1).

These calculations assume that U.S. forces are limited by a START treaty. Moreover, the calculations describe a future year--perhaps many years hence--when, assuming Soviet air defenses continue to improve, the B-1B would no longer be a pure penetrating bomber. In this long-term period, available B-2 bombers would be penetrators; the B-1B bombers would first stand off from the Soviet Union and attack with cruise missiles and would then penetrate and attack with short-range weapons.

While the capacity of the U.S. bomber fleet would be significantly reduced in this long-term period, the reduction in warheads actually available in a war might be smaller because of limits on the size of weapons inventories. Under current procurement plans for short-range attack missiles, and assuming a typical mix of types of weapons aboard U.S. bombers, not all bombers in a fleet that included 132 B-2 aircraft would be fully loaded. Thus, the fleet might carry only about 4,000 warheads, less than its full capacity (see Case III in Table 1). Canceling further purchases of B-2 bombers might lead to heavier loading of existing B-1B bombers and, as a result, a more modest reduction in available warheads than would be suggested by reductions in capacity. Specifically, total bomber warheads might only decrease by about 15 percent, while total strategic warheads covered under START might decrease by about 6 percent (compare Cases III and V in Table 1).

Heavier loading of B-1B aircraft may be feasible since--without many B-2 aircraft--most of the aerial refueling capacity of the tanker fleet could be dedicated to the B-1B fleet. While it may be difficult for a bomber to have the range and survivability to deliver dozens of nuclear weapons, the Soviet Union could not be certain of how many weapons these aircraft are carrying or of how many might reach their targets. Hence, the warheads may still contribute to deterrence.

Nevertheless, for missions that require particularly long flights or stressful tactics, it may not be possible to load the B-1B bomber more heavily because one bomb bay may be reserved for additional fuel. If a particular wartime scenario requires that all B-1B bombers fly these lengthy or stressful missions, then canceling the B-2 bomber program would result in the loss of about one-third of all bomber weapons and about 14 percent of total warheads (compare Cases III and IV in Table 1). Different assumptions would lead to still other reductions in warheads. For example, reductions of warheads would also occur if the United States buys either 66 bombers or 33 bombers--the two alternative sizes of total buys that CBO examined.

The same general results would be realized in an interim period when the B-1B bomber would still be able to operate as a penetrating bomber. The Air Force now believes that the B-1B bomber could be effective as a pure penetrating bomber (that is, one that did not carry any cruise missiles) for many years. Under the START counting rules, if the B-1B bomber were designated as a pure penetrator, it would count as carrying only one warhead, even though it would actually carry

TABLE 1. NUMBERS OF WARHEADS AVAILABLE IN THE LONG TERM,
ASSUMING START LIMITS

	Number of Bombers			On-Line Warheads	
	B-2	B-1B	B-52H	Bombers Only	All Forces ^a
Estimates Based on the Maximum Capacity of Bombers to Carry Weapons ^b					
Case I: 132 B-2s	132	97	0	5,200	9,900
Case II: No More B-2s	15	97	0	3,500	8,300
Estimates Based on Available Weapons and Typical Weapons Mix ^c					
Case III: 132 B-2s	132	97	0	4,000	8,700
Case IV: No More B-2s	15	97	0	2,700	7,500
Case V: No More B-2s, Heavier Loading of B-1Bs ^d	15	97	0	3,400	8,200
Case VI: 66 B-2s	66	97	0	3,500	8,300
Case VII: 33 B-2s	33	97	0	3,000	7,800

SOURCE: Congressional Budget Office.

NOTES: Numbers of warheads are rounded to the nearest hundred.

Estimates are based on a long-term period, perhaps around the year 2010, when the B-1B might no longer be a pure penetrator and would also carry cruise missiles. Where there is still disagreement, START limits reflect the U.S. proposal.

- a. Includes all forces covered by START.
- b. Estimates assume the following capacities: B-2 carries 16 weapons; B-1B carries 36 weapons.
- c. Estimates reflect limits on short-range attack missiles (SRAM II). Except where noted, estimates assume the following loads: B-2 carries up to 10 SRAM II and 6 gravity bombs; B-1B carries up to 8 SRAM II, 8 gravity bombs, and 12 cruise missiles. Total available (on-line) SRAM II is assumed to be 1,470.
- d. Loads are as in note "c" except that the B-1B is assumed to carry up to 16 SRAM II, 8 gravity bombs, and 12 cruise missiles.

many more. Thus, if the B-1B bomber were a penetrator under START, the United States could retain B-52H bombers carrying cruise missiles. That would increase the total number of warheads available on the U.S. bomber fleet, but the percentage changes associated with canceling or curtailing the B-2 bomber program in the interim period would be similar to those in the long term (see Table A-1 in the Appendix).

Reduction in the Ability to Penetrate

If Soviet air defenses continue to improve, canceling or curtailing the B-2 bomber program could reduce the ability of the U.S. bomber fleet to penetrate Soviet air defenses and deliver warheads on target. This reduction in capability to penetrate may be exacerbated if fewer bombers are each carrying more weapons. The bomber fleet would eventually number only about 100 aircraft if no additional B-2s are purchased. CBO cannot quantify these effects, but they could be important.

The B-2 bomber is designed to use stealth technology to increase the chances of evading Soviet radar, especially the advanced radar systems the Soviet Union may deploy in coming years. If the bomber performs as designed, and if Soviet air defenses continue to improve, the B-2 bomber should have a substantially higher probability of surviving Soviet air defenses and delivering warheads than the current bomber fleet. The Air Force argues strongly that this capability is important in helping to deter nuclear war. The B-2 bomber could also increase nuclear deterrence by adding to the types of potential threats faced by the Soviet Union--including threats from penetrating bombers, standoff bombers carrying cruise missiles, and missiles launched from submarines and land-based systems.

In addition, the B-2 could be useful in other missions. Because it would have a human pilot, the Air Force believes the plane represents the best hope of detecting and destroying Soviet targets that are mobile or relocatable--such as mobile, land-based missiles. The stealth capability of the B-2 bomber could also be important if the plane is used in conventional (non-nuclear) roles that demand penetrating sophisticated enemy air defenses.

The B-2 bomber's stealth capability may be less useful if, because of easing world tensions and its own budgetary limitations, the Soviet Union does not deploy or delays deploying improved air defenses. In this case, the ability of the B-1B bomber to penetrate Soviet air defenses would not be reduced as rapidly or as severely as was expected a few years ago.

COST OF THE ADMINISTRATION'S PLAN

According to the April 1989 Five-Year Defense Program--the most recent available plan--the Administration intends to buy 132 B-2 bombers. Orders for the bombers would be placed each year through 1996, with a maximum annual purchase of 30 B-2 bombers occurring in 1995 (see Table 2).

TABLE 2. B-2 ALTERNATIVE PRODUCTION PROFILES
 (In numbers of planes)

Options	1990 and Before						Total After 1995	Total Program
	1991	1992	1993	1994	1995			
CBO Reestimate of Administration Plan ^a	15	5	10	21	24	30	27	132
The Number of Planes in Various Options								
I. Buy 132, One Year Low Rate	15	2	5	10	21	24	55	132
II. Buy 132, Stretch Buy	15	5	10	11	13	13	65	132
III. Buy 66, Admin- istration Planned Rates	15	5	10	21	15	0	0	66
IV. Buy 66, 3 per Year	15	3	3	3	3	3	36	66
V. Buy 66, 2 per Year	15	2	2	2	2	2	41	66
VI. Buy 33, 3 per Year	15	3	3	3	3	3	3	33
VII. Buy 33, 2 per Year	15	2	2	2	2	2	8	33
VII. Cancel, Finish R&D	15	0	0	0	0	0	0	15

SOURCE: Congressional Budget Office.

a. Includes five of the six development aircraft that, according to the Air Force, will be modified and delivered as operational aircraft at the completion of flight test.

CBO's Estimate of the Administration's Plan

CBO estimates that this Administration plan would cost \$75.4 billion in constant 1991 dollars of budget authority (see Table 3). This estimate includes costs for procurement, research and development, and military construction. Not included are operating costs, which are discussed briefly later in this paper.

Except where noted, CBO uses 1991 dollars in this analysis because it examines the costs of alternatives that buy B-2 aircraft over a widely varying number of years. Use of current dollars--which include future inflation--could lead to misleading comparisons if, for example, one alternative assumed B-2 purchases over five years and so included inflation for that period, while another alternative involved purchases and inflation over twenty years.

The Administration, however, often states its estimates of the cost of the B-2 program in current dollars. The most recent available Administration estimate, which was made last year, stated that the Administration's planned buy of 132 B-2 bombers would cost \$70.2 billion in current dollars. In contrast, CBO estimates that the Administration's program would cost \$76.7 billion in current dollars (see Table A-2).

CBO's estimate is higher for several reasons. The largest part of the increase (about \$3.9 billion) reflects CBO's assumption that prices will rise somewhat more rapidly than the Administration assumed last year (see Table A-3). CBO also includes in its estimates other costs (\$2.6 billion) that the Air Force has indicated are likely to occur. The clearest example of these costs is \$1.5 billion in product improvement programs--that is, modifications to the current B-2 design that the Air Force intends to make. CBO's estimate also reflects changes in the program made since last year, including the effects of reducing the 1990 buy size of the B-2 bomber imposed by the Congress. Program changes made since last year actually resulted in a modest reduction in costs because the added procurement costs from reducing the size of the buy were more than offset by other changes, including reductions in spending for research and military construction.

Possible Cost Increases

In testimony before the Policy Panel of the House Committee on Armed Services, the General Accounting Office (GAO) noted that B-2 costs have increased beyond earlier Administration estimates and that further increases are possible. GAO attributed past increases in B-2 costs to incomplete aircraft design at the time manufacturing was started, estimates of material costs that were based on comparisons with earlier types of aircraft containing different materials, and other problems that delayed the production schedule and consequently drove up costs. GAO also anticipated future cost increases stemming from revised inflation rates, the recent strike at the Boeing Company (a major B-2 subcontractor), and the possibility that testing will reveal problems in performance that would require additional funds to correct.

TABLE 3. COSTS OF B-2 OPTIONS
 (In billions of 1991 dollars of budget authority)

Options	1990 and Before	1991	1992	1993	1994	1995	Total After 1995	Total Program
CBO Reestimate of Administration Plan	30.4	5.7	8.2	9.1	7.5	7.2	7.2	75.4
The Costs of Various Options								
I. Buy 132, One Year Low Rate	30.4	4.4	5.7	8.4	8.2	7.5	14.2	78.8
II. Buy 132, Stretch Buy	30.4	5.7	8.6	6.4	5.5	5.0	23.4	84.9
III. Buy 66, Admin- istration Planned Rates	30.4	5.7	6.5	8.6	5.1	0.2	0.4	56.8
IV. Buy 66, 3 per Year	30.4	5.0	4.8	5.0	4.2	3.7	43.0	96.1
V. Buy 66, 2 per Year	30.4	4.6	4.4	4.7	3.9	3.3	67.1	118.4
VI. Buy 33, 3 per Year	30.4	5.0	4.6	4.9	4.1	3.7	4.0	56.7
VII. Buy 33, 2 per Year	30.4	4.5	4.2	4.5	3.8	3.3	13.6	64.4
VIII. Cancel, finish R&D	30.4	1.6	1.0	0.7	0.1	0.0	0.0	33.9

SOURCE: Congressional Budget Office computations based on budget data.

NOTE: Numbers may not add to totals because of rounding.

CBO agrees with GAO that the costs of the Administration's program could increase above recent estimates, but CBO cannot predict the amount of any increase with confidence. Costs of new programs at the leading edge of technology are always hard to estimate. Furthermore, there are special estimating problems unique to the B-2 program. For example, detailed cost estimates for the first 10 planes that were authorized and appropriated before 1989 are still highly classified and are not available to CBO.

CBO can, however, illustrate the possibility for growth in costs by estimating increases that could occur if particular costing assumptions made by the Administration do not work out as planned. For example, weapons programs follow a "learning curve." The knowledge gained from producing a weapon leads to efficiencies that gradually lower costs. The DoD data imply a learning curve for the B-2 bomber that assumes that efficiencies and cost reductions are realized more rapidly than was the case for other aircraft, including the B-1B bomber. Of course, the B-2 bomber employs new stealth technology. With new technology there is more to learn; that is, more opportunities exist for efficiencies and associated cost reductions. Thus, the rapid learning curve and resulting efficiencies assumed in estimating B-2 costs may be reasonable.

If this rapid learning does not take place, however, B-2 costs would rise--perhaps substantially. Learning curves are often defined in terms of the percentage of reduction in unit costs that occurs each time there is a doubling in the total number of aircraft produced. CBO estimates that, if the assumption for the B-2 program's learning curve is optimistic by one percentage point, total costs could increase by about \$3 billion. The learning curve assumed for the B-2 bomber is several percentage points more optimistic than the rate of learning achieved under the B-1B bomber program.

In addition, a total of \$8.8 billion in cost reductions (expressed in current dollars) are already assumed in current Administration estimates, as well as in CBO's estimates, but may not be fully realized. These include \$3.6 billion in initiatives to reduce costs, which DoD expects will be undertaken by the contractor. The initiatives include purchasing special equipment to speed production and reduce costs. CBO has a list of the initiatives but no firm basis for judging whether they would save the amounts claimed or whether these initiatives to reduce costs will be undertaken, given the uncertainty surrounding the number of B-2 aircraft that will be bought.

Another \$2.4 billion in cost reduction stems from the assumption that the B-2 bombers would be purchased on a multiyear basis--that is, under a contract that guarantees the purchase of a certain number of planes each year and allows the contractor to realize efficiencies by purchasing component parts in large lots. Realizing this cost reduction, however, requires Congressional approval of the multiyear contract.

Yet another \$2.8 billion in cost reduction is associated with fixed-price options in the current contract, which might not remain available if there are changes in the timing of the B-2 program.

COSTS OF ALTERNATIVE B-2 PROGRAMS

CBO examined the budgetary impact of eight options dealing with the B-2 program. These alternatives vary the total number of B-2 aircraft that are purchased as well as the rate at which aircraft are purchased. As a result, the options differ widely in three key measures that are each of concern to the Congress: the total cost of the B-2 program, the maximum cost in any one year, and the cost per plane. The alternatives we discussed illustrate how these key measures vary depending on decisions the Congress will make about the B-2 program. For example, holding down the annual rate of buy would reduce the maximum cost in any one year but would drive up the cost per plane and, depending on the size of the total buy, may also increase total program costs.

CBO's budget estimates should provide reasonable estimates of the costs of each alternative relative to the Administration's program and other alternatives. But CBO's estimates are based on Administration estimates, which are beset by the uncertainties discussed above. Therefore, CBO's estimates provide only a rough guide to absolute costs.

The details of the analysis are presented in Table 2, which shows the number of B-2 aircraft bought under each alternative, and in Tables 3 through 5, which show the three key measures of cost. The remainder of this section discusses a few findings CBO reached based on analysis of the eight alternatives.

Buy 132 Aircraft More Slowly

Total costs will increase if the Congress decides to buy 132 total aircraft, as the Administration proposes, but buys them more slowly.

Another Year at Low Rate. For example, 132 aircraft could be purchased at the Administration's rates but after one more year of production at a low rate. That might mean buying only two planes in 1991, compared with buying the five planes proposed by the Administration, and then returning to the Administration's planned buy rates but delayed by one year (that is, the 1991 planned buy in 1992, the 1992 planned buy in 1993, and so forth). Table 2 shows annual buys under this approach.

This option would give the Air Force more time to test the aircraft before a high rate of procurement begins. With additional testing, problems could be discovered and corrected without the need for changes, which could be expensive, in aircraft already in production. By effectively postponing a final decision, this option would also give decisionmakers more time to ponder the requirements for B-2 bombers in light of ongoing changes in U.S. security requirements.

These benefits, however, come at a price. Because the contractor is bearing costs during the year the program is delayed, CBO estimates that overall costs would increase by about \$3.4 billion, bringing the total cost of the program to \$78.8 billion (see Tables 3 and 4). Cost increases could be larger if, because of the delay, DoD

**TABLE 4. COSTS AND SAVINGS OF B-2 OPTIONS (In billions of 1991 dollars
of budget authority)**

Options	1990 and Before						Total After 1995	Total Program
		1991	1992	1993	1994	1995		
CBO Reestimate of Administration Plan	30.4	5.7	8.2	9.1	7.5	7.2	7.2	75.4
Cost Changes Under Various Options								
I. Buy 132, One Year Low Rate	0.0	-1.4	-2.6	-0.7	0.7	0.3	7.0	3.4
II. Buy 132, Stretch Buy	0.0	0.0	0.3	-2.7	-2.0	-2.3	16.2	9.5
III. Buy 66, Admin- istration Planned Rates	0.0	0.0	-1.8	-0.5	-2.4	-7.0	-6.9	-18.6
IV. Buy 66, 3 per Year	0.0	-0.7	-3.5	-4.1	-3.2	-3.6	35.8	20.7
V. Buy 66, 2 per Year	0.0	-1.1	-3.9	-4.4	-3.6	-3.9	59.9	43.0
VI. Buy 33, 3 per Year	0.0	-0.7	-3.6	-4.2	-3.4	-3.6	-3.2	-18.7
VII. Buy 33, 2 per Year	0.0	-1.2	-4.0	-4.5	-3.7	-3.9	6.4	-11.0
VIII. Cancel, Finish R&D	0.0	-4.1	-7.2	-8.4	-7.3	-7.2	-7.2	-41.5

SOURCE: Congressional Budget Office computations based on budget data.

NOTE: Numbers may not add to totals because of rounding.

can no longer exercise the fixed-price options in the current contract or if it loses other cost advantages. (Table A-4 lists assumptions about these factors and estimates the effect of losing these advantages.) Moreover, under this approach, the maximum spending in any one year could be as much as \$8.4 billion.

Reduce Annual Buys. The planned 132 aircraft could also be bought at reduced annual rates of procurement, which would reduce maximum costs in any one year. The Administration plans to buy as many as 30 aircraft a year. Instead, the Congress could plan to buy no more than 13 aircraft per year, which would mean that orders for all 132 aircraft would be completed in the year 2000 compared with 1996 under the Administration's plan (see Table 2).

Compared with the Administration's plan, this approach would limit the number of aircraft bought before testing is complete, thus reducing the cost of any modifications that might have to be made as a result of testing. Perhaps more important, under this approach, annual spending after 1990 would average \$5.3 billion a year compared with \$7.3 billion under the Administration's plan--a reduction of \$2 billion a year. In most years under this approach, spending would be less than \$6 billion (see Table 3).

As with the previous option, however, these benefits would increase the total cost. More years of production mean more years of overhead costs. Also, to the extent that economies of scale are available at higher rates of production, they are lost under this approach. CBO estimates that the approach would raise total program costs by \$9.5 billion to a level of about \$84.9 billion.

There are, of course, other approaches that would buy 132 aircraft more slowly. For example, the Congress could impose a production break--that is, buy no aircraft in 1991 and then resume production. CBO cannot estimate the savings under such a production break with confidence in part because the costs of a production break would depend on decisions about how quickly production should be resumed, which would affect the number of personnel who would have to be maintained on the payroll during the break.

Moreover, CBO does not have detailed data on the costs of the first 10 B-2 aircraft. These data, which remain highly classified, would be required--along with other information and assumptions--if estimates of the costs of a production break are to be made.

Buy 66 Aircraft at Administration Rates

Buying fewer B-2 bombers, but at the Administration's planned rate, would reduce the total cost of the program. One approach would follow the same planned annual rates of purchase proposed by the Administration but stop after buying 66 aircraft. That would mean ordering aircraft only until 1994 compared with 1996 under the Administration's plan. Buying 66 aircraft at the Administration's rates would reduce total costs by \$18.6 billion to a level of \$56.8 billion. But maximum costs in a particular year would still reach \$8.6 billion. Estimates for this approach assume that--because annual rates of procurement would be substantial--DoD could still realize a portion of the cost savings associated with the fixed-price options, multiyear

procurement, and the initiatives to reduce costs. (Table A-4 estimates the effects of altering these assumptions.)

Buy B-2 Aircraft Slowly

To hold down maximum annual spending, B-2 aircraft could be bought at low rates. CBO examined buy rates of either two or three aircraft a year. At these rates, maximum annual spending would never exceed \$5 billion. But the remaining period of the buy--and hence fixed costs--would stretch over many years. Moreover, CBO assumes that savings associated with multiyear procurement, the initiatives to reduce costs, and the fixed-price options would not be realized. At such low rates of procurement, the manufacturer may be too uncertain of the program's fate to make investments that would reduce costs.

These various factors mean that the total costs of the B-2 program would be reduced only if there were large reductions in the total buy. For example, if only 33 total aircraft were procured, total costs could decrease below those under the Administration's program by \$18.7 billion (at three aircraft per year) or \$11 billion (at two aircraft per year). If a total of 66 aircraft were purchased, however, then the added overhead and loss of economies of scale would more than offset the savings from buying fewer total aircraft. Compared with costs under the Administration's program, total costs of buying 66 aircraft would increase by \$20.7 billion (at three aircraft per year) or \$43 billion (at two aircraft per year).

Moreover, regardless of whether 33 or 66 aircraft are procured, the cost per plane soars when buy rates are reduced to two or three a year. There are many ways to define cost per plane. The definition used here--total cost (development, procurement, and construction) divided by the total number of aircraft purchased--is useful for comparisons among alternatives but may not be appropriate when comparing the costs of the B-2 aircraft with those of other planes.

Using this measure, the cost per plane rises to almost \$2 billion if 33 aircraft are bought at two per year (see Table 5). This cost per plane would be about 3 1/2 times higher than the \$570 million per plane that would be incurred under the Administration's plan. The higher costs per plane reflect several factors: the inefficiencies of slow buys, the loss of benefits from the learning curve (later planes, which are not bought because the total buys are smaller, would have been cheaper to build), and the amortization of the fixed costs of research and development over a smaller total buy.

Cancel But Finish Development

Finally, the Congress could cancel further procurement of the B-2 bomber program but finish the research and development program in order to have available a fully developed aircraft. Compared with costs under the Administration's plan, canceling and completing the research and development would save a total of \$41.5 billion. Savings would be higher--about \$45 billion--if the Congress canceled all further pro-

TABLE 5. COSTS PER PLANE (In millions of 1991 dollars of budget authority)

	Total Costs (Including sunk costs) ^a	Total Costs (Excluding sunk costs) ^b
CBO Reestimate of Administration Plan	570	380
Costs per Plane Under Various Options		
I. Buy 132, One Year Low Rate	600	410
II. Buy 132, Stretch Buy	640	470
III. Buy 66, Administration Planned Rates	860	520
IV. Buy 66, 3 per Year	1,460	1,290
V. Buy 66, 2 per Year	1,790	1,720
VI. Buy 33, 3 per Year	1,720	1,460
VII. Buy 33, 2 per Year	1,950	1,890
VIII. Cancel, Finish R&D	2,260	n.a.

SOURCE: Congressional Budget Office computations based on budget data.

NOTE: n.a. = not applicable

- a. Costs include all those for procurement, research and development, and military construction (for example, \$75.4 billion of the CBO's reestimate for the Administration's plan) divided by the number of aircraft purchased (for example, 132 planes for the Administration's plan).
- b. Costs exclude budget authority authorized in 1990 and earlier years. Number of aircraft excludes aircraft authorized in 1990 and earlier years.

curement and military construction and provided no additional research and development dollars. Savings could also be increased further because contracts have not yet been signed obligating DoD to spend some of the monies appropriated for the B-2 bomber in 1989 and 1990. Some of these funds might be saved if cancellation occurred before the contracts are signed. Alternatively, there could be some added costs--which are not reflected in CBO's estimate of savings--associated with terminating the B-2 program, perhaps including costs to store manufacturing tooling and to dispose of planes and parts that are incomplete.

OPERATING COSTS

This paper has focused on changes in the investment costs required to develop and procure the B-2 bomber. But CBO also looked into how much a fleet of B-2 bombers might cost to operate--that is, the funding for military pay, operation and maintenance, and spare parts required to keep the fleet flying. Since the Air Force has no experience operating the B-2 bomber, costs of operation are highly uncertain. But the Air Force estimates that operating a fleet of 132 B-2 bombers would cost about \$1.4 billion a year--a figure that represents the gross costs of B-2 operations.¹ The net additional cost to operate the entire U.S. bomber fleet could be lower assuming that some B-52 bombers are eventually deactivated.

This estimate is based on a mathematical model the Air Force uses to estimate costs for all of its systems. Comparing estimates from the model for existing aircraft with operating costs in the budget, however, suggests that actual operating costs for the B-2 could be substantially higher than \$1.4 billion a year. For example, the Air Force model estimates costs for operating existing B-52 bombers that are about 30 percent lower than costs shown in the Air Force budget. Similarly, the model estimates costs for operating the B-1B bomber fleet that are about 20 percent less than costs in the budget.

These underestimates reflect costs that are shown in the budget but are not captured in the Air Force model. If the estimates from this model are underestimating the B-2 bomber's operating budget for similar reasons, then the budget for operating 132 B-2 bombers could range from \$1.8 billion a year (using the B-1B analogy) to \$2 billion a year (using the B-52 analogy).

¹ The Air Force estimates operating costs of \$900 million in constant 1981 dollars. CBO adjusted this estimate to 1991 dollars of budget authority.

APPENDIX TABLES

TABLE A-1. NUMBERS OF WARHEADS AVAILABLE IN AN INTERIM PERIOD ASSUMING START LIMITS

	<u>Number of Bombers</u>			<u>On-Line Warheads</u>	
	B-2	B-1B	B-52H	Bombers Only	All Forces ^a
Estimates Based on Maximum Capacity of Bombers to Carry Weapons ^b					
Case I: 132 B-2s	132	97	95	5,800	10,500
Case II: No More B-2s	15	97	95	3,600	8,400
Estimates Based on Available Weapons and Typical Weapons Mix ^c					
Case III: 132 B-2s	132	97	95	4,600	9,300
Case IV: No More B-2s	15	97	95	2,900	7,600
Case V: No More B-2s, Heavier Loading of B-1Bs ^d	15	97	95	3,500	8,200
Case VI: 66 B-2s	66	97	95	4,100	8,900
Case VII: 33 B-2s	33	97	95	3,600	8,400

SOURCE: Congressional Budget Office.

NOTES: Number of warheads are rounded to the nearest hundred.

Estimates are based on an interim period when the B-1B would be a pure penetrator under the START counting rules. Where there is still disagreement, the START limits reflect the U.S. proposal.

- a. Includes all forces covered by START.
- b. Estimates assume the following capacities: B-2 carries 16 weapons; B-1B carries 36 weapons.
- c. Estimates reflect limits on short-range attack missiles (SRAM II). Except where noted, estimates assume the following loads: B-2 carries up to 10 SRAM II and 6 gravity bombs; B-1B carries up to 8 SRAM II, 8 gravity bombs, and 12 cruise missiles. Total available (on-line) SRAM II assumed to be 1,470.
- d. Loads are as in note "c" except that the B-1B is assumed to carry up to 16 SRAM II, 8 gravity bombs, and 12 cruise missiles.

TABLE A-2. COSTS OF B-2 OPTIONS (In billions of current dollars of budget authority)

Options	1990 and Before	1991	1992	1993	1994	1995	Total After 1995	Total Program
CBO Reestimate of Administration Plan								
	26.8	5.7	8.6	9.8	8.4	8.5	8.9	76.7
The Costs of Various Options								
I. Buy 132, One Year Low Rate	26.8	4.4	5.9	9.1	9.2	8.8	17.7	81.9
II. Buy 132, Stretch Buy	26.8	5.7	8.9	6.9	6.2	5.8	31.0	91.3
III. Buy 66, Administration Planned Rates	26.8	5.7	6.7	9.3	5.7	0.3	0.5	55.0
IV. Buy 66, 3 per Year	26.8	5.0	5.0	5.4	4.8	4.3	65.2	116.5
V. Buy 66, 2 per Year	26.8	4.6	4.5	5.1	4.4	3.9	123.3	172.5
VI. Buy 33, 3 per Year	26.8	5.0	4.8	5.3	4.6	4.3	4.9	55.7
VII. Buy 33, 2 per Year	26.8	4.5	4.4	4.9	4.2	3.9	17.6	66.3
VIII. Cancel, Finish R&D	26.8	1.6	1.1	0.7	0.2	0.0	0.0	30.4

SOURCE: Congressional Budget Office computations based on budget data.

NOTE: Numbers may not add to totals because of rounding.

TABLE A-3. CHANGES IN TOTAL PROGRAM COST UNDER CBO'S REESTIMATE OF THE ADMINISTRATION'S PLAN FOR THE B-2 ADVANCED TECHNOLOGY BOMBER (In billions of dollars of budget authority)

Category	Total Program in Current Budget Authority	Total Program in 1991 Budget Authority
Administration Fiscal Year 1990-1991 Budget Revision, April 1989	70.2	71.3
CBO's Higher Inflation Rates	3.9	2.1
Preplanned Product Improvement Modifications	1.5	1.1
Other Administration Changes	1.5	1.3
Other Congressional Actions	<u>-0.4</u>	<u>-0.5</u>
CBO Reestimate of Adminis- tration 1990/1991 Plan	76.7	75.4

SOURCE: Congressional Budget Office computations based on budget data.

NOTE: Numbers may not add to totals because of rounding.

TABLE A-4. EFFECTS OF ALTERNATIVE SAVINGS ASSUMPTIONS ON TOTAL PROGRAM COSTS
 (In billions of current dollars of budget authority)

		<u>Multiyear Savings</u>		<u>Cost Reduction Initiatives</u>		<u>Fixed Price Saving</u>	
	Included in Option	Cost Change		Included in Option	Cost Change	Included in Option	Cost Change
CBO Reestimate of Administration Plan	Yes	2.4		Yes	3.6	Yes	2.8
I. Buy 132, One Year Low Rate	Yes	2.4		Yes	3.6	Yes	2.8
II. Buy 132, Stretch Buy	Yes	2.4		Yes	3.6	Yes	2.8
III. Buy 66, Administration Planned Rates	Yes	1.2		Yes	1.8	Yes	1.4
IV. Buy 66, 3 per Year	No	n.a.		No	n.a.	No	n.a.
V. Buy 66, 2 per Year	No	n.a.		No	n.a.	No	n.a.
VI. Buy 33, 3 per Year	No	n.a.		No	n.a.	No	n.a.
VII. Buy 33, 2 per Year	No	n.a.		No	n.a.	No	n.a.
VIII. Cancel, Finish R&D	No	n.a.		No	n.a.	No	n.a.

SOURCE: Congressional Budget Office computations based on budget data.

NOTES: n.a.=not applicable

The savings included in CBO's reestimate of the Administration's plan were provided by the Air Force in current dollars. CBO was not, however, given any further details such as the amount of savings assumed in each year, or the basis for the estimates. CBO has no firm method for judging whether the estimates of savings will or will not be achieved. Therefore, these estimates represent a very rough indication of the possible costs.